* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] In the rechargeable lithium-ion battery which extends each charge collector of the aforementioned positive-electrode electrode and a negative-electrode electrode, and was connected to the positive-electrode terminal and the negative-electrode terminal as the lead section while carrying out the laminating of a positive-electrode electrode and the negative-electrode electrode by turns through separator The lead section of the aforementioned charge collector is made into the fuse section. The cross section of this fuse section The rechargeable lithium-ion battery characterized by being referred to as resistivity (muomega, mm) x positive-electrode electrode area (mm2) x2.41x10-6 [of a charge collector] of a resistivity (muomega, mm) x positive-electrode electrode area (mm2) x4.27x10-7< fuse section cross-section (mm2) < charge collector.
[Claim 2] In a rechargeable lithium-ion battery according to claim 1, aluminum is used as a charge collector of the aforementioned positive-electrode electrode, and it is 1.31x10-7x positive-electrode electrode area (mm2) < fuse section cross-section (mm2) <6.80x10-7x positive-electrode electrode area (mm2) about the cross section of this fuse section.
The rechargeable lithium-ion battery characterized by carrying out.
[Claim 3] The rechargeable lithium-ion battery characterized by having used copper as a charge collector of the aforementioned negative-electrode electrode, and making the cross section of this fuse section into 7.34x10-8x positive-electrode electrode area (mm2) < fuse cross-section (mm2) <3.51x10-7x positive-electrode electrode area (mm2) in a rechargeable lithium-ion battery according to claim 1.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the rechargeable lithium-ion battery of the square shape of high capacity and high power.
[0002]
[Description of the Prior Art] Conventionally, the rechargeable lithium-ion battery of the square shape of high capacity and high power is used for the power supply of various electronic equipment, the power supply of an electric vehicle, etc.
[0003] It seems that the rechargeable lithium-ion battery of this square shape is shown in drawing 4 and drawing 5 . Namely, in drawing 4 , as for 10, the length of the longitudinal direction to which thickness changes from the comparatively thin griddle which performed nickel plating, for example by 0.5mm shows 280mm and the flat square shape cell container of the cell of the closed mold 115mm and whose thickness the lengthwise length is 30mm. It carries out as [contain / the layered product 14 which carried out / the positive-electrode electrode 2 wrapped in by the saccate separator 8 in this flat square shape cell container 10 / the laminating of the 47 sheets for the negative-electrode electrode 3 to 46 sheets by turns].
[0004] It is to both sides of the positive-electrode charge collector 5 which consists of the aluminum aluminum foil whose thickness of the shape of a 265mm wide and 107mm long rectangle is 20 micrometers as this positive-electrode electrode 2 as shown in drawing 4 and drawing 5 , the multiple oxide 2, for example, LiCoO, of Lithium Li and transition metals. It covers as a positive active material 4.

[0005] Moreover, as a negative-electrode electrode 3, as shown in drawing 4 and drawing 5 , the thickness of the shape of a 270mm wide and 109mm long rectangle puts the carbon which has the carbon, for example, graphite structure, in which a dope and a ** dope of Lithium Li are possible, such as carbon and difficulty graphitized-carbon material, as a negative-electrode active material 6 on both sides of the negative-electrode charge collector 7 which consists of the copper Cu foil which is 10 micrometers.
[0006] Moreover, separator 8 is what made the saccate the films, a fine porosity polyethylene film, a polypropylene film, etc., of two sheets whose thickness of the shape of a little larger rectangle than the positive-electrode electrode 2 and the negative-electrode electrode 3 is 25 micrometers, as shown in drawing 4 and drawing 5 , and it wraps in this positive-electrode electrode 2 and the negative-electrode electrode 3 with this saccate separator 8, respectively.
[0007] It carries out as [expose / in the conventional example of this drawing 4 / by making predetermined width of face of the charge collectors 5 and 7 by the side of each one side of the rectangle-like positive-electrode electrode 2 and the negative-electrode electrode 3, and the other sides into the lead section / from separator 8].
[0008] As 46 sheets of the positive-electrode electrode 2 wrapped in by this saccate separator 8 and 47 sheets of the negative-electrode electrode 3 are shown in drawing 4 , a laminating is carried out by turns.

Form the rectangle-like layered product 14, and where the lead section of the charge collector 5 by the side of [2] one side of the layered product 14 of the shape of this rectangle (i.e., a positive-electrode electrode) is piled up, it consists for example, of aluminum aluminum. It carries out as [weld / cover positive-electrode lead object 11a which is in the lengthwise length of this positive-electrode electrode 2, abbreviation, etc. by carrying out, for example, has a length of 100mm at an overall length, and / by ultrasonic welding].

[0009] Moreover, it carries out as [weld / cover negative-electrode lead object 12a which piled up the lead section of the charge collector 7 by the side of / 3 / the other sides which counter the one side side of the layered product 14 of the shape of this rectangle (i.e.,, a negative-electrode electrode) and which is a state, for example, consists of Copper Cu, and is in the lengthwise length of this negative-electrode electrode 3, abbreviation, etc. by carrying out, for example has a length of 100mm at an overall length, and] It carries out as [contain / the layered product 14 by which this positive-electrode lead object 11a and negative-electrode lead object 12a were welded / in this flat square shape cell container 10].

[0010] Moreover, it is LiPF6 in the mixed solvent of propylene carbonate and diethyl carbonate in the flat square shape cell container 10 of this closed mold. The organic electrolytic solution 9 which dissolved at a rate of one mol/l. is poured in, and it carries out as [fill / between this positive active material 4 and the negative-electrode active material 6 / with this organic electrolytic solution 9].

[0011] Moreover, it carries out as [connect /, respectively / positive-electrode lead object 11a and negative-electrode lead object 12a / in drawing 4 / to the external positive-electrode terminal 11 and the external negative-electrode terminal 12]. the drawing 4 **** -- 13 is a relief valve which extracts the gas of this interior, when the internal pressure of the flat square shape cell container 10 of this closed mold becomes higher than a predetermined value

[0012] According to **** and the example of drawing 4 , average voltage can obtain the rechargeable lithium-ion battery of 47Ah(s) by 4.0V.

[0013]

[Problem(s) to be Solved by the Invention] However, generation of heat having taken place to this rechargeable battery itself, while the defect of this rechargeable battery itself being damaged arose, when the internal short circuit occurred by the part in a laminating electrode, there was **** by which a high current flows into the short circuit section from a laminating electrode and this high current flowed in for high capacity and high power, and the **** rechargeable lithium-ion battery's having un-arranged [which emits a lot of heat to the circumference].

[0014] this invention stops the flow of the high current by the internal short circuit in view of ****** in an instant, and it aims at being made to make small injury of this cell itself, and influence on the circumference.

[0015]

[Means for Solving the Problem] As this invention rechargeable lithium-ion battery is shown in drawing 1 , drawing 2 , and drawing 3 In the rechargeable lithium-ion battery which extends each charge collector 5 and 7 of this positive-electrode electrode 2 and the negative-electrode electrode 3, and was connected to the positive-electrode terminal 11 and the negative-electrode terminal 12 as the lead sections 5a and 7a while carrying out the laminating of the positive-electrode electrode 2 and the negative-electrode electrode 3 by turns through separator 8 The lead sections 5a and 7a of these charge collectors 5 and 7 are made into the fuse section. The cross section of this fuse section is set to area (mm2) x2.41x10-6 of the resistivity (muomega, mm) x positive-electrode electrode of the area (mm2) x4.27x10-7< fuse section cross-section (mm2) < charge collector 5.7 of the resistivity (muomega, mm) x positive-electrode electrode 2 of charge collectors 5 and 7.

[0016] Moreover, this invention rechargeable lithium-ion battery uses aluminum as a charge collector 5 of the positive-electrode electrode 2 in ****, as shown in drawing 1 and drawing 2 , and it makes the cross section of this fuse section the area (mm2) of the area (mm2) < fuse section cross-section (mm2) <6.80x10-7x positive-electrode electrode 2 of the 1.31x10-7x positive-electrode electrode 2.

[0017] Moreover, as shown in drawing 1 and drawing 3 , this invention rechargeable lithium-ion battery

uses copper as a charge collector 7 of the negative-electrode electrode 3 in ****, and makes the cross section of this fuse section the area (mm2) of the area (mm2) < fuse cross-section (mm2) <3.51x10-7x positive-electrode electrode 2 of the 7.34x10-8x positive-electrode electrode 2.

[0018]

[Function] Since the positive-electrode electrode 2 and the negative-electrode electrode 3 which the fuse sections 5a and 7a were melted at the time of an internal short circuit, and prevented the poor cell beforehand, and this internal short circuit generated since the fuse sections 5a and 7a of the predetermined cross section were formed in each charge collector 5 and 7 of the positive-electrode electrode 2 and the negative-electrode electrode 3 according to this invention are separated electrically, it can be again used as a cell.

[0019]

[Example] Hereafter, with reference to drawing 1 , drawing 2 , and drawing 3 , I will explain per example of this invention rechargeable lithium-ion battery. In this drawing 1 , drawing 2 , and drawing 3 , the same sign is given to the portion corresponding to drawing 4 and drawing 5 , and the detailed explanation is omitted.

[0020] Also in this example of drawing 1 like the drawing 4 conventional example by 0.5mm with comparatively thin thickness The 280mm and lengthwise length 115mm, [the length of the longitudinal direction which consists of the griddle which performed nickel plating] In the flat square shape cell container 10 of the cell of the closed mold whose thickness is 30mm, with the saccate separator 8 the negative-electrode electrode 3 wrapped in by 46 sheets and the saccate separator 8 in the wrapped-in positive-electrode electrode 2 -- 47 sheets -- the negative-electrode electrode 3, the positive-electrode electrode 2, the negative-electrode electrode 3, and .... it carries out as [contain / the layered product 14 which carried out the laminating to the order of the negative-electrode electrode 3 by turns]

[0021] It is LiNiO, the multiple oxide 2, for example, LiCoO, of Lithium Li and transition metals,2 to both sides of the positive-electrode charge collector 5 which consists of the aluminum aluminum foil whose thickness of the shape of a 265mm wide and 107mm long rectangle is 20 micrometers as this positive-electrode electrode 2 as shown in drawing 1 , drawing 2 , and drawing 5 . It covers as a positive active material 4.

[0022] Moreover, as a negative-electrode electrode 3, as shown in drawing 1 , drawing 3 , and drawing 5 , the thickness of the shape of a 270mm wide and 109mm long rectangle puts the carbon which has the carbon, for example, graphite structure, in which a dope and a ** dope of Lithium Li are possible, such as carbon and difficulty graphitized-carbon material, as a negative-electrode active material 6 on both sides of the negative-electrode charge collector 7 which consists of the copper Cu foil which is 10 micrometers

[0023] Moreover, as shown in drawing 1 and drawing 5 , separator 8 is what made the saccate the films, a fine porosity polyethylene film, a polypropylene film, etc., of two sheets whose thickness of the shape of a little larger rectangle than the positive-electrode electrode 2 and the negative-electrode electrode 3 is 25 micrometers, and wraps in this positive-electrode electrode 2 and the negative-electrode electrode 3 with this saccate separator 8, respectively.

[0024] In this example, while extending the predetermined width of face by the side of one side of each charge collector 5 and 7 of the positive-electrode electrode 2 of the shape of this rectangle, and the negative-electrode electrode 3, and the other sides and exposing from separator 8 as the lead sections 5a and 7a, it carries out as [make /, respectively / these lead sections 5a and 7a / into the fuse section].

[0025] In this example, it determines by carrying out so that the width of face of each lead section 5a and 7a of this positive-electrode electrode 2 and the negative-electrode electrode 3, i.e., the cross section of the fuse section, may be described below. In such a rechargeable battery, although the area per [to be used] electrode (capacity) and the laminating number of sheets (the total capacity) of an electrode can determine the cross section of the fuse section arbitrarily, it is desirable to usually make it 5 or less Ahs in consideration of the property of cells, such as a load characteristic, as a capacity per electrode. It determines about the cross section of the fuse section of the cell which uses it as a capacity per sheet also

in this example, carrying out the laminating of the electrode of 5 or less Ahs.
[0026] It seemed that the high current was passed to each of the aluminum aluminum foil with a thickness of 20 micrometers used for charge collectors 5 and 7, and a copper Cu foil with a thickness of 10 micrometers in order to see the prearcing time current characteristic of these fuse sections 5a and 7a, and the result which searched for the property of the cross section (mm2) and current (A) which are melted by 90msec by examination was shown in drawing 6 and drawing 7 .
[0027] Moreover, when the external short circuit was performed using the cell of capacity 47Ah as approximation of the current which flows into the electrode which caused the short circuit at the time of an internal short circuit, the current more than 1000A flowed momentarily, after 30 seconds, 850A flowed again and there was a phenomenon in which current value fell rapidly after that.
[0028] Based on the relation between current value and the cross section in **** proportionality being by the examination of this current characteristic, drawing 6 , and drawing 7 , it is the cross section of fuse section 5a of the charge collector 5 of aluminum 1.5mm 2 It carries out and is the cross section of fuse section 7a of the copper charge collector 7 0.83mm 2 It carried out.
[0029] When cell capacity is the rechargeable lithium-ion battery of the example of the book of 47Ah(s) here, For less than 0.1 msecs, the prearcing time of fuse section 5a of the charge collector 5 of the aluminum of the positive-electrode electrode 2 is [the size of the cross section of the fuse section] 2 a maximum of 1.76mm from it being an indispensable condition. Shell, minimum cross-section 0.34mm2 for the current energization whose elevation temperature is less than 10 degrees C in the 141A energization of 3C at the time of cell use up to -- it is -- moreover, fuse section 7a of the charge collector 7 of the copper of the negative-electrode electrode 3 -- a maximum of 0.91 -- mm2 from -- minimum cross-section 0.19mm2 for the current energization at the time of cell use up to -- it is .
[0030] It carries out from ****, and generally, the cross section of these fuse sections 5a and 7a can be determined by carrying out so that it may state below. The cell capacity of this rechargeable lithium-ion battery is decided by the gross area of the positive-electrode electrode 2. since the effective area of one side of the positive-electrode electrode 2 of this example is a little smaller than 265mmx107mm, it is the double precision whose one sheet is the both sides and this is 46 sheets -- the gross area -- abbreviation 2.59x106 mm2 it is .
[0031] Therefore, the range of the cross section of the lead section when using aluminum as a charge collector 5 of the positive-electrode electrode 2, i.e., fuse section 5a, is as follows.
(0.34mm2 / 2.59x106 mm 2**1.31x10-7) Area of the cross-section (mm2) <(1.76mm2 / 2.59x106 mm 2**6.80x10-7) x positive-electrode electrode of area (mm2) < fuse section 5a of x positive-electrode electrode [0032] Moreover, the range of the cross section of the lead section when using copper as a charge collector 7 of the negative-electrode electrode 3, i.e., fuse section 7a, is as follows.
(0.19mm2 / 2.59x106 mm 2**7.34x10-8) Cross-section (mm2) <(0.91mm2 / 2.59x106 mm 2**3.51x10-7) x positive-electrode electrode area of x positive-electrode electrode area (mm2) < fuse section 7a (mm2)
[0033] As 47 sheets of the negative-electrode electrode 3 wrapped in by 46 sheets and the saccate separator 8 of the positive-electrode electrode 2 which were wrapped in by this saccate separator 8 are shown in drawing 1 , carry out a laminating by turns and the rectangle-like layered product 14 is formed. Where the one-side side of the layered product 14 of the shape of this rectangle, i.e., the lead section of the positive-electrode electrode 2, i.e., fuse section 5a, is piled up, it consists for example, of aluminum aluminum. the lengthwise length of this positive-electrode electrode 2, and abbreviation -- while having equal length, it carries out as [weld / this / of positive-electrode lead object 11a which has a crevice in the position corresponding to this lead section i.e., fuse section 5a, / by ultrasonic welding]
[0034] Moreover, where the other side side, i.e., the lead section of the charge collector 7 of the negative-electrode electrode 3, i.e., fuse section 7a, which counter the one-side side of the layered product 14 of the shape of this rectangle is piled up for example, copper Cu -- changing -- the lengthwise length of this negative-electrode electrode 3, and abbreviation -- while having equal length, it carries out as [weld / this / of negative-electrode lead object 12a which has a crevice in the position corresponding

to this lead section, i.e., fuse section 7a, / by ultrasonic welding]
[0035] It carries out as [contain / the layered product 14 by which this positive-electrode lead object 11a and negative-electrode lead object 12a were welded / in this flat square shape cell container 10]. Moreover, it is LiPF6 in the mixed solvent of propylene carbonate and diethyl carbonate in the flat square shape cell container 10 of this closed mold. The organic electrolytic solution 9 which dissolved at a rate of 1 mol / 1 is poured in, and it carries out as [fill / between this positive active material 4 and the negative-electrode active material 6 / with this organic electrolytic solution 9]. In this case, since a metal thin film is melted by generating of the Joule's heat by the short-circuit current so that it may mention later in this example, it is necessary to select this electrolytic solution so that the electrolytic solution may not cause a chemical change etc. with heat.
[0036] Moreover, in this example, it carries out as [connect /, respectively / positive-electrode lead object 11a and negative-electrode lead object 12a / as shown in drawing 1 / to the external positive-electrode terminal 11 and the external negative-electrode terminal 12]. According to the example of ******, average voltage can obtain the rechargeable lithium-ion battery of 47Ah(s) by 4.0V.
[0037] Furthermore, at the time of charge, a lithium begins to melt as a lithium ion into the electrolytic solution which sank into separator 8 from the positive active material 4 of the positive-electrode electrode 2, and it combines with the negative-electrode active material 6 of the negative-electrode electrode 3 taking lessons from the rechargeable lithium-ion battery of this example, and stating, and the lithium ion combined with the negative-electrode active material 6 of the negative-electrode electrode 3 dissociates at the time of electric discharge, it is emitted into the electrolytic solution, and repeats charge and discharge by combining with the positive active material 4 of the positive-electrode electrode
[0038] In this case, a lithium may deposit on the negative-electrode electrode 3 by gap of the positive-electrode electrode 2 and the negative-electrode electrode 3. Even if this lithium serves as a dendrite (arborescence), it breaks through separator 8 and the internal short circuit of the positive-electrode electrode 2 and the negative-electrode electrode 3 occurs The fuse sections 5a and 7a which served as the lead section prepared at positive and the negative-electrode electrodes 2 and 3, respectively are melted by this positive and negative-electrode inter-electrode that were short-circuited by the excessive current by the short-circuit current which concentrates and flows in from positive [other] and a negative-electrode electrode. Positive [other] and the influx of the current from the negative-electrode electrodes 2 and 3 are prevented after it.
[0039] Therefore, it is loss of only positive [which caused the internal short circuit in this case], and a negative-electrode electrode, and the injury on this rechargeable lithium-ion battery and the damage to the circumference can be prevented to the minimum. Furthermore, only positive and the negative-electrode electrode which carried out the internal short circuit will be separated, and operation of this rechargeable lithium-ion battery is attained again.
[0040] incidentally -- cell capacity 47Ah of the above-mentioned example -- the cross section of the lead section of the charge collector 5 of the aluminum of the positive-electrode electrode 2, i.e., fuse section 5a, -- 1.5mm2 The cross section of the lead section of the charge collector 7 of the copper of the negative-electrode electrode 3, i.e., fuse section 7a, is 0.83mm2 It has a rechargeable lithium-ion battery in the fully-charged state where an open circuit voltage is 4.16V. as a false examination of an internal short circuit Although voltage once descended to 1.45V in start 2 seconds as a result of checking whether pegging is performed and current can be intercepted, until after the about 1 minute, voltage returned gradually and it recovered to 4.03V. The temperature rise of this cell is also about +20 degrees C of atmospheric temperature, and is understood that this example is effective.
[0041] Moreover, it is the cross section of fuse section 5a of the charge collector 5 of the aluminum of the positive-electrode electrode 2 the above-mentioned minimum cross section of 0.34mm2 at cell capacity 47Ah of the above-mentioned example 2 It carries out. The cross section of fuse section 7a of the charge collector 7 of the copper of the negative-electrode electrode 3 is made into the above-mentioned minimum cross section of 0.19mm. After checking that there are no abnormalities in a deed about the usual charge and discharge in this rechargeable lithium-ion battery, As a result of checking whether it has

in the state of the full charge of open-circuit-voltage 4.16V, pegging is performed as a false examination of an internal short circuit, and current can be intercepted, although voltage once descended to 2.56V in start 0.5 seconds, voltage returned to 4.12V immediately after it. Moreover, the temperature rise of this cell is also about +8 degrees C of atmospheric temperature, and is understood that this example is effective.

[0042] In addition, although attached and stated to the example which used aluminum as a charge collector 5 of the positive-electrode electrode 2 in the above-mentioned example, and used copper as a charge collector 7 of the negative-electrode electrode 3, other metals, such as stainless steel and nickel, can be used as these charge collectors 5 and 7. Let the cross section of the fuse sections 5a and 7a when using other metals as these charge collectors 5 and 7 be the **** range shown below in consideration of the resistivity of aluminum and copper in ****. Resistivity (muomega, mm) x positive-electrode electrode area (mm2) x2.41x10-6(muomega, mm)-1[0043] of a resistivity (muomega, mm) x positive-electrode electrode area (mm2) x4.27x10-7(muomega, mm)-1< fuse section cross-section (mm2) < charge collector of a charge collector Moreover, this invention of the ability of various composition to take is natural, without deviating from the summary of this invention, without restricting to the above-mentioned example.

[0044]

[Effect of the Invention] Since the positive-electrode electrode and negative-electrode electrode which the fuse section was melted at the time of an internal short circuit, and prevented the poor cell beforehand, and generated this internal short circuit since the fuse [the lead section-cum-] section of the predetermined cross section was prepared in each charge collector of a positive-electrode electrode and a negative-electrode electrode according to this invention are separated electrically, there are profits which can be again used as a cell.

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* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cross section showing one example of this invention rechargeable lithium-ion battery.
[Drawing 2] the example of the positive-electrode electrode of drawing 1 is shown -- it is notch front view in part
[Drawing 3] the example of the negative-electrode electrode of drawing 1 is shown -- it is notch front view in part
[Drawing 4] It is the cross section showing the example of the conventional rechargeable lithium-ion battery.
[Drawing 5] It is the diagram with which explanation of a rechargeable lithium-ion battery is presented.
[Drawing 6] It is the diagram with which explanation of this invention is presented.
[Drawing 7] It is the diagram with which explanation of this invention is presented.
[Description of Notations]
2 Positive-Electrode Electrode
3 Negative-Electrode Electrode
4 Positive Active Material
5 Positive-Electrode Charge Collector
5a Fuse [the lead section-cum-] section
6 Negative-Electrode Active Material
7 Negative-Electrode Charge Collector
7a Fuse [the lead section-cum-] section
8 Separator
9 Electrolytic Solution
10 Flat Square Shape Cell Container
11 External Positive-Electrode Terminal
11a Positive-electrode lead object
12 External Negative-Electrode Terminal
12a Negative-electrode lead object
14 Layered Product

[Translation done.]